SLOT LOADED RMSA WITH INVERTED U SHAPE CUT IN FINITE GROUND PLANE

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Abstract:
This paper presents a comparative study of the radiation characteristics of the microstrip patch geometry on infinite ground plane and finite ground plane and found that there is an increase in bandwidth by introducing the patch geometry on finite ground plane. In the proposed antenna a single fed, single layer, inverted U shaped finite ground plane is considered. This antenna is designed and optimized to operate at multiple frequencies with wideband operations. The proposed antenna operates at 1.65 GHz and 2.42 GHz with multiband and wideband applications.

KEYWORDS: bandwidth, microstrip antenna, multiband, return loss, wideband

1. Introduction

Conventional microstrip antennas in general have a conducting patch printed on a grounded substrate. However microstrip antennas inherently have a narrow bandwidth [1-12] and bandwidth enhancement is usually demanded for practical applications. In addition, applications in present day mobile communication systems usually require smaller antenna size in order to meet the miniaturization requirements of mobile units. Thus size reduction and bandwidth enhancement are becoming major design considerations for practical applications of microstrip antennas. Numerous applications such as satellite links, wireless local network, cellular telephones, synthetic aperture radars and radio frequency identification systems require dual frequency antennas. When antenna operates over a finite band width at both of the frequencies, it is known as dual-band antenna.
In the proposed antenna, modification of the surface current distribution is made by means of introducing an inverted U shaped slot to improve the impedance bandwidth along with the ground plane area reduction.
The electromagnetic simulation of the proposed antenna has been carried out using IE3D software of Zeland Software. VSWR, input impedance, return loss, smith chart, directivity, antenna gain, radiating efficiency and radiation pattern etc. can be evaluated using IE3D software.

2. Antenna Design Specification

Figure 1 shows the rectangular micro strip patch antenna design 1. The patch is printed on inexpensive FR4 having dielectric constant (Єr) of 4.4 and height 1.6 mm. The coaxial connector is used to feed the antenna. The 50-ohm coaxial cable with SMA connector is used for probe feeding. Loss tangent tan δ = 0.02, resonance frequency f_{c1} = 1.5 GHz with BW= 40 MHz (2.66%), resonance frequency f_{c2} = 1.69 GHz with BW= 30 MHz (1.77%), resonance frequency f_{c3} = 2.38 GHz with BW= 120 MHz (5.04%), frequency range = 0 GHz to 3 GHz, step frequency = 0.01 GHz, length of patch L = 47 mm**,** width of patch W = 62 mm, with a slot cut of width 2 mm at coordinates from patch center {(23.5,-1), (-21.5,-1), (-21.5,1), (23.5,1)}, feed point location from patch center = (20, 28). Figure 2 shows the variation of return loss with frequency for design 1. Figure 3 shows the impedance loci for design 1.

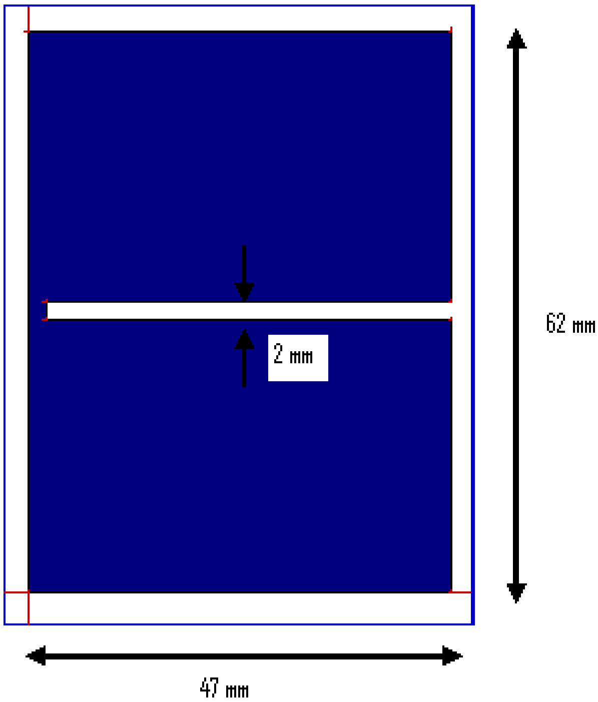

Fig.1. Rectangular micro strip patch antenna of proposed design 1 (Top view).

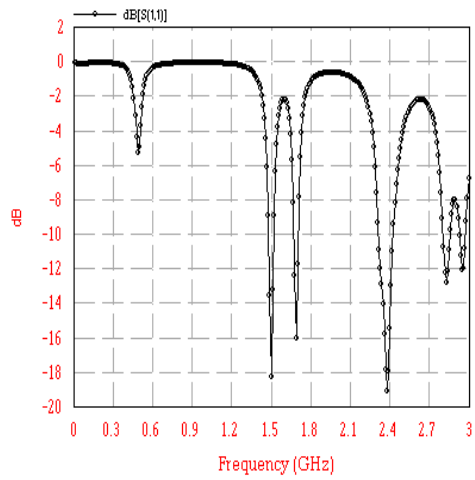

Fig.2. Variation of return loss with frequency for design 1

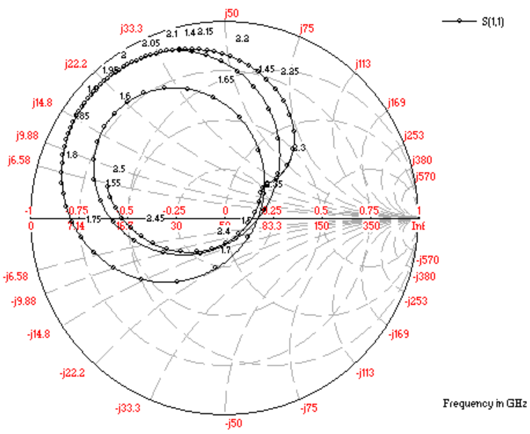

Fig.3. Impedance Loci for design 1

With the same design parameters an effort is made to enhance the bandwidth if the finite ground plane is considered. Figure 4 shows slot loaded RMSA with inverted U shape cut in finite ground plane of proposed design 2. In this proposed antenna design, a slot of 44.6 mm × 23 mm ($L \times W$) is cut in the finite ground plane to increase the band width. Which gives lower resonance frequency f_{c1} = 1.65 GHz with BW= 50 MHz (3.03%), higher resonance frequency f_{c2} = 2.42 GHz with BW= 140 MHz (5.78%), frequency range = 0 GHz to 3 GHz, step frequency = 0.01 GHz, for this design, the ground plane dimensions would be given as:

L(g)=6h+L=6(1.6)+47 mm= 56.6 mm

W(g)=6h+W=6(1.6)+62 mm=71.6 mm

length of patch L = 47 mm**,** width of patch W = 62 mm, with a slot cut of width 2 mm at coordinates from patch center {(23.5,-1), (-21.5,-1), (-21.5,1), (23.5,1)}, feed point location from patch center = (20, 28). Figure 5 shows the variation of return loss with frequency for design 2. Figure 6 shows the impedance loci for design 2.

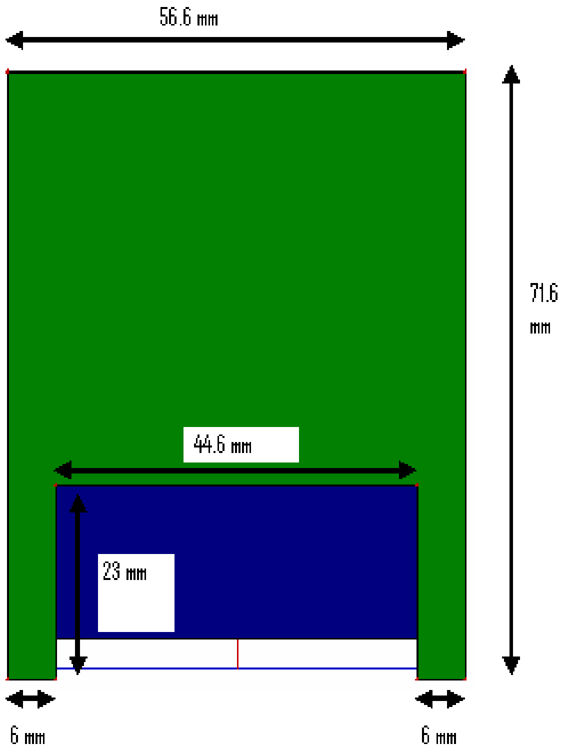

Fig.4. slot loaded RMSA with inverted U shape cut in finite ground plane of proposed design 2 (Back view)

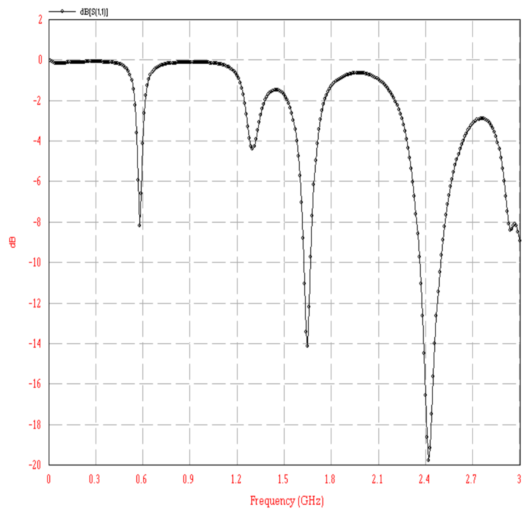

Fig.5. Variation of return loss with frequency for design 2

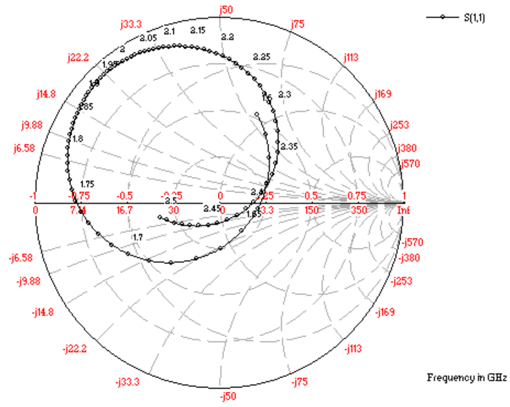

Fig.6. Impedance Loci for design 2

3. Result and Discussions

The simulation result of the proposed antenna has been carried out by using IE3D software. Infinite ground plane micro strip antenna of proposed design 1 gives resonance frequency f_{c1} = 1.5 GHz with BW= 40 MHz (2.66%), resonance frequency f_{c2} = 1.69 GHz with BW= 30 MHz (1.77%), resonance frequency f_{c3} = 2.38 GHz with BW= 120 MHz (5.04%), whereas for slot loaded RMSA with inverted U shape cut in finite ground plane of proposed design 2, lower resonance frequency f_{c1} = 1.65 GHz with BW= 50 MHz (3.03%), higher resonance frequency f_{c2} = 2.42 GHz with BW= 140 MHz (5.78%), which gives multiband and wide impedance bandwidth. Therefore proposed antenna operates with multiband and wideband applications, so the antenna is acceptable.

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